Public and Private Investment in the Hydrocarbon-Based Rentier Economies: A Case Study for the GCC Countries

Ibrahim Ari, Erhan Akkas, Mehmet Asutay, Muammer Koc

Abstract

This study investigates the causal relationship between public and private investments between 1960-2015 in the GCC countries (i.e., Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates), which are known to be rentier states and making significant policy changes and efforts to diversify their economies, This paper provides quantitative evidence based on empirical findings to, first, support the claim that oil-based rentier economies strongly rely upon public investment, and second, to test whether their attempts or claims to achieve some level of economic diversification has been achieved or not. Structural time breaks reveal that these countries should be still considered as the rentier economies away from economic diversification because they still strongly depend upon oil and natural gas resources, and thereby the entire break points have occurred at the time of oil crises. This research reveals that there exists a non-linear dependency in the entire datasets, and thereby non-linear causality is performed to extract true information behind the scene, beyond the linear causality. As a result of non-linear causality, the findings enable us to make some recommendations as follows; (i) pursue the goals stated in their national visions to diversify their economies, (ii) provide access to quality education for all to build a fundamental foundation for economic diversification, (iii) cultivate the social attachment between business and society to ensure inclusive and diversified economic activities by all segments of society, (iv) legislate and amend the policies towards encouraging and protecting private investment by a larger portion of their population, (v) investigate the economic and financial opportunities for the GCC countries in terms of their geography, climate, population, language, and even religion, (vi) facilitate international trade to export and re-export, (vii) to reduce the number of expats and increase high-skilled local workforce. In short, the empirical analysis conducted in this research can be considered as a valuable contribution for filling a gap in the development of the GCC countries, post petroleum era in particular.

1. Introduction

Public and private investment, along with the interrelations in between, have been studied and reported largely in the literature since 1980s due to the paradigm shifts in global economics and the change in the economic dynamics, particularly, in developing countries. Public investment plays a prominent role in the creation of physical assets including economic infrastructure (roads, railways, highways, airports, seaports, power plants, energy network, and so on) and social infrastructure (universities, hospitals, nursing homes, public schools, and so on) to develop a society and country. On the other hand, private investments are mostly profit-driven businesses to generate income on capital assets and financed by non-governmental organizations, institutions, private entities, and individuals in order to maximize their own benefits. They can promote or crowd out each other depending on quality and quantity of human capital, geographic and cultural circumstances, natural resources, and policies of the countries. For instance, public investment promotes human resource development that has a positive impact on private investment by increasing productivity and overall innovation capacity in a country. However, unbalanced public investment may also crowd out private investment by exploiting scarce resources, thereby reducing economic growth (Khan & Kumar, 1997). In this regard, this study has examined the crowding out and promoting effects of public and private investment for rentier economies in the case of the GCC countries. The findings of this study can enable us to make a projection for the future economic move in these and similar countries by revealing what kind of investment should be synchronized to diversify their economies for a healthy and sustainable development.

The neoclassical approach has been centered upon the idea of re-distribution of national income between private and public sector without any change in economic growth (Hyder & Qayyum, 2001: 633). This school of economy also advocates that public investment has a negative impact on private investment. On the other hand, Keynesian school counters this idea of neoclassical thought by arguing that public investment stimulates the private investment with a multiplier effect (Hyder and Qayyum, 2001:633; Saeed et al., 2006: 639), thereby increasing economic growth. In other words, private decision-makers become willing to invest their capital on a country with a better physical, social and economic infrastructure that causes economic growth (Hassan *et al*., 2011; Ramirez, 1994; and Hyder and Qayyum, 2001).

There is a serious challenge faced by hydrocarbon-based rentier states that is not only to stimulate private investments for a larger share of a non-oil/gas based services or manufacturing,

but also innovate alternative investment policies for a sustainable economic diversification. In this sense, almost all GCC countries have developed their national visions around the nexus of economic diversification, transitioning to the knowledge-based economy and sustainable development for the post-petroleum era (BNV 2030, 2015; KDP 2020, 2015; KSAV 2030, 2008; ONV 2020, 2013; QNV 2030, 2008; The Abu Dhabi 2030, 2008). They recognize that public and private investment plays a profound role in an economic development. In the GCC countries, Figure 1 represents the fluctuations and overall increase in public and private investment for the period of 1960-2015. As can be seen, public and private investment has been sharply increased or decreased in these countries accompanied by the fluctuations in oil prices. The trends in 'Saudi Arabia and UAE', and 'Qatar and Kuwait' reflect similar behavior in pairwise while Bahrain and Oman shows different characteristics, possibly caused by the limited and depleting natural resources. However, it should be noted that there is a visible increase in both of public and private investment, particularly from 2000 to 2014, mainly due to a steady-state increase in oil and natural gas extraction and their global prices.

Figure 1: Public and Private Investment in the GCC Countries (1960-2015)

There always exists a constant risk of decreasing oil prices and diminishing hydrocarbon reserves that applies pressure on the governments of oil-based rentier states (henceforth interchangeable with the GCC countries) to bring into alternative economic and financial policies to promote investments for permanent generation of non-oil/gas-based economies into

effect. The state budgets in the GCC, which is a primary source of public investment, consists of mainly hydrocarbon-based revenue changing in different, but high, levels, for example from 77 to 93 percent in 2011 (Hvidt, 2013). This means that public investment heavily relies on the natural resources, and thereby developments of the countries are strongly dependent on oil and natural gas. This indicates that the oil/gas revenues that have played a profound role in the development of these counties substitute for public investment. However, a balanced development and an expansion of the economies against potential risks requires two main conditions as follows; (i) public and private investment should move up together by triggering each other towards sustainable, balanced and growing economic as well as social and environmental development, and (ii) resource-based, such as from oil/gas, revenues should be considerably decreased in the share of state budget by increasing revenues from manufacturing, services, construction and other sectors mainly stimulated by private investments. This study focuses on the first condition to define the possible problems on the investment behavior and make recommendations by exploring the following objectives: (i) to investigate the structural time breaks of public and private investment to discuss the effect of oil crises, (ii) to analyze a long-term relationship between public and private investment with a co-integration test analysis, (iii) to explore the linear causality, along with the direction, between public and private investment for the GCC countries, (iv) to examine the nonlinear causality between public and private investment for the GCC countries, if there exists nonlinearity in public investment data.

To the best of author's knowledge, this is the first study investigating the quantitative relationships between public and private investments for the GCC countries. This paper provides an opportunity to evaluate public and private investment by investigating the linear causal relationship in between, along with the direction of the causality. Moreover, this study reveals that there exists a non-linear dependence in the entire datasets, and thereby non-linear causality was also performed to extract true information behind the scene, beyond the linear causality. Therefore, the empirical analysis conducted in this research should be considered as a contribution for filling a gap in the development of the GCC countries, post petroleum era in particular.

2. Empirical Literature Review

There exists a general consensus that public and private investments have direct influence on economic growth in different scales (Khan and Kumar, 1997; Khan and Reinhart, 1990). However, the empirical studies reveal that there is a crowding out or negative (Cavallo and Daude, 2011; Everhart and Sumlinski, 2001; Nazmi and Ramirez, 1997) and complementary or

positive (Aschauer, 1989; Blejer and Khan, 1984; Erden and Holcombe, 2005; Ramirez, 1994; Odedokun, 1997; and Hassan *et al*., 2011) effects of public investment on private investment. Thus, it is important to analyze the existing literature on public and private investment in this section to gain a better understanding of public and private investment and its articulations.

Cavallo and Daude (2011) examined the relationship between public and private investment whether public investment is blessing or curse for private investment by conducting 116 developing countries for the period of 1980-2006. The results show that if developing countries have strong institutions with a marginal productivity of public investment (such as the construction of roads, railways, seaports, power plants, energy network, and so on), then it is possible to indicate that there is a positive impact of public investment on private investment so that it is a matter of crowding in effect in these countries. If they have weak institutions, its effect would be *vice versa*. Therefore, being a good institution playes a significant role in mediating the relationship between public and private investments (Cavallo and Daude, 2011: 67). However, the answer to the question of whether the public investment is a blessing or curse is that it is a 'mixed blessing' depending on existing institutions in countries (Cavallo and Daude, 2011: 78).

By shifting the focus on the correlation between public and private investment, Everhart and Sumlinski (2001) showed that there is a negative correlation between them but there has been a change for the better in terms of the qualities of institutions according to the sample of 63 developing countries for the period spanning from 1970 to 2000. However, Erden and Holcombe (2005) presented that there is a positive correlation between public and private investment in 19 developing countries for the period of 1980-1997, but not in the developed countries (Erden and Holcombe, 2005: 580). However, they stated that if the public and private investors are in competition for the same resources, there could be a crowd out effect on the private investments (Erden and Holcombe, 2005: 578). Cavallo and Daude (2011) also indicated that substantial funds need to be raised for public investment, and thereby this could reduce the source and amount of available financing that increases the interest rate of the financing loan, then it would have a negative impact and crowding out on the private investment (Cavallo and Daude, 2011: 66).

In considering the sectorial analysis of the impact of public and private investment, Saeed *et al*., (2006) also examined different sectors such as agriculture and manufacturing by conducting Granger causality. The results show that while public investment promotes private investment in

agricultural sector and overall economy, there is a negative impact of public investment on private investment through crowding out effect in manufacturing sector. In a similar way, Looney (1995) also investigated the relationship between public and private investment in manufacturing sector in Pakistan by performing Granger Causality test. The results show that public investment crowds out private sector in manufacturing industry. Furthermore, Hassan *et al*. (2011) examined the impact of public investment on private investment by sectors such as agriculture, industry and trade, transportation and communication, and construction in Malaysia for the period of 1976-2006. The results present that there is a positive relation in between by promoting the private investment. According to Pereira (2001), public investment based on sectorial analysis does not have an influence on private investment by considering the sectors of information, industry, and transportation in the USA for the period of 1956-1997. The results illustrate that industry and transportation sectors in aggregate level, public investment has a positive influence on the private investment while it crowds out private investment in the information sector.

Naqvi (2002) showed that public investment promotes the private investment in Pakistan for the period of 1964-2000. In another study, Naqvi and Tsoukis (2003) investigated that the interrelationships between public and private investment in Bangladesh, India, Indonesia, Malaysia, Pakistan, and Thailand for the years spanning from 1971 to 2000 by conducting Granger causality test. However, Indonesia removed from econometric analysis because of the lack of long-term data, and thereby five Asian countries are considered in their study. According to the results, the relationship between public and private investment differs from one country to another as follows; public investment (i) promotes private investment in Pakistan; (ii) crowds out the private investment in Thailand; (iii) supports neutrality hypothesis by showing no relationship with private investment in any direction in India and Malaysia; and (iv) shows the endogeneity in Bangladesh.

As for public and private capital accumulation with respect to the public and private investment, Aschauer (1989) examined the relationships among public capital accumulation, private investment, and the return to private capital in the USA for the period of 1953-1986. The results revealed that higher public investment crowds out the private investment, although it raises the national investment rate. However, an increase in the public capital stock leads to the return to private capital so it crowds in the private capital accumulation.

The matter of public and private investment has been also investigated through global price of crude oil in the literature. Mallick *et al*. (2018) examined the impact of oil prices, public investment, real interest rate, financial sector development, economic growth, and economic globalization on private investment in India for the period of 1980-2014. The results show that oil price, public investment, and interest rate have negative influence on private investment while financial sector development, economic growth, and globalization has positive impact. Therefore, the study suggests that India should focus to boost up the production and consumption of renewable energy and find alternative energy sources to reduce their dependency on import of crude oil.

In summary, the literature shows that the relationship and dynamics between public and private investments have been long studied from different angles and under different country contexts. According to the literature, private investment is necessary for economic progress for branching out into diverse and sophisticated sectors while it has to be based on solid and reliable physical (such as transportation, communication, energy), social (such as education and health) and financial (such as banking regulations) infrastructure, which is mainly developed by public investments. Furthermore, the relationship between public and private investments become positively impactful on the overall economic development if the right policies and institutions are put together to stimulate each other, not to crowd out. In fact, rentier economies need more private investment to make ready their economy for the risk of post-petroleum era. Therefore, the GCC countries are a good case study on this issue.

3. Methodology

In this part, we explain the country selection and data-gathering process for the case study of rentier economies to analyze causal relationship between public and private investment. Next, a unified framework showing a general concept (*Figure 2*) and detailed approach is presented with the steps including unit root tests, along with structural breaks, confirmatory analysis, co-integration test, linear and nonlinear causality. Unit root tests analyze the time series whether they are stationary or not, and examine whether both public and private investment data for the same country have the same order of integration or not. Afterwards, co-integration test investigates the long-run relationship by sharing common trends between time series for each country before giving insights into the causality. In the following step, linear and nonlinear causality is performed to understand the causal relationship and its direction between public and private investment. In this regard, panel data involves public and private investment spanning the time period of 1960-2015 for each country. This annual data for public and private

investment was gathered from International Monetary Fund (IMF) Fiscal Affairs Department for the period of 1960-2015 (IMF, 2017a, 2017b).

3.1. Framework for causality

This study follows a framework, as depicted in *Figure 2*, that presents a systematic approach enabling us to analyze the time series of public and private investment for structural time breaks, linear and nonlinear Granger causality. The holistic framework consists of three parts represented by color-coded columns in *Figure 2*.

Pretesting: In the orange-colored column, two unit root tests, Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981) and Zivot-Andrew (ZA) (Zivot & Andrews, 1992) tests, were chosen to investigate the integration orders of public and private investment for each country considered in this study. Meanwhile, the ZA test provides structural time breaks of the datasets. Next, the integration orders of public and private investment obtained from ADF and ZA tests were examined pairwise to check whether the results from both are matched by confirmatory analysis. For example, the integration order of public investment for Bahrain can be concluded as one ($I_{pub}(1)$) if and only if public investment becomes stationary in the first integration order of both ADF and ZA tests, otherwise the result is considered as inconclusive. Afterwards, the integration orders of public and private investment for the same country was compared to each other to see whether they matched in the same number. For instance, integration orders of public and private investment for Bahrain are separately conclusive and same with each other, $I_{pub}(1) = I_{pri}(1)$. In the second stage, Johansen (1992) co-integration test was selected to analyze the long-run relationship between associated time series as a pretest for Granger causality. In the end, if public and private investment for the same country meets the same integration order and not to have a cointegration in between them, then standard Granger (1969) causality is performed to investigate causality, otherwise Toda-Yamamoto Granger causality (Toda & Yamamoto, 1995) is conducted (see *Figure 2*).

Linear Causality: In the blue-colored column, as a result of pretesting condition, standard Granger (1969) or Toda-Yamamoto Granger (Toda & Yamamoto, 1995) causality test, which both are linear model, is employed on the datasets for further analysis. This depends on the condition of pretest, which is equality of integration numbers of time series, and no cointegration between them for the same country. If it is satisfied, then we use standard Granger causality, otherwise Toda-Yamamoto Granger causality (see *Figure 2*).

Nonlinear Causality: In the green-colored column, the BDS test is performed to determine nonlinearity of the time series by examining public investment whether is a series of *independent and identically distributed* (i.i.d.) random variables (Brock, Dechert, & Scheinkman, 1987). Next, nonlinear Granger causality proposed by Diks and Panchenko (2006) is conducted to investigate nonlinearity between public and private investment if the BDS test confirms that there exist a nonlinearity in one of the time series (*see*: *Figure 2*).

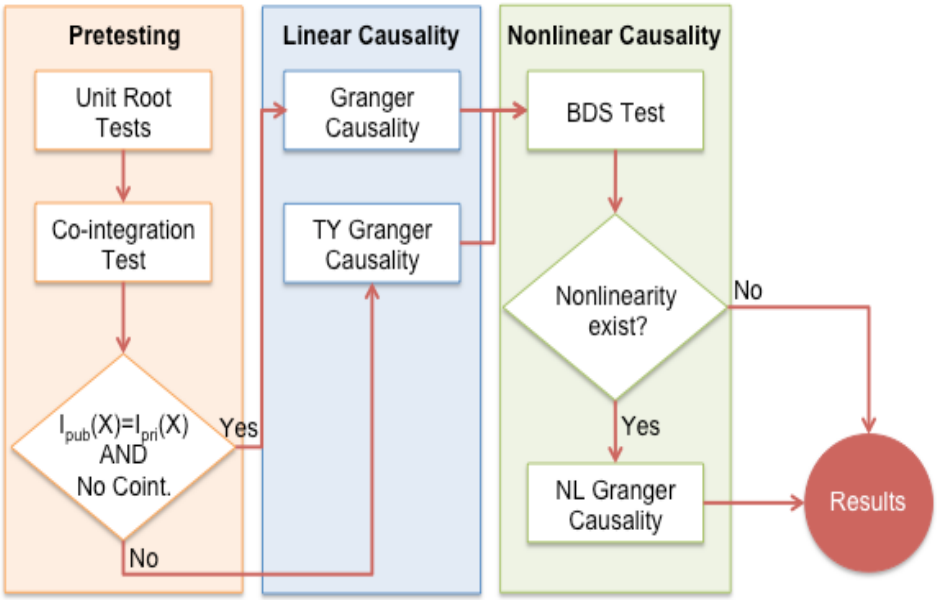

Figure 2. *Framework for testing causality.*

3.2. Confirmatory analysis

Confirmatory analysis is employed to determine whether the time series are stationary in the same integration order for both unit root tests, ADF and ZA. For this purpose, the integration orders were consolidated into a table to compare the results under two conditions; (i) the integration orders obtained from both ADF and ZA tests for each time series must be equal; and (ii) the integration orders of two datasets (i.e., public and private investment for the same country) associated pairwise must be the same number for both. For instance, public investment for Bahrain, first, becomes stationary in the 1st integration order of both the ADF and ZA test, and second, private investment for Bahrain is also stationary in the same order with public investment. As a result, these two conditions are confirmed for Bahrain to enable us to investigate standard Granger causality between public and private investment.

3.3. Toda-Yamamota (TY) Granger causality

In finance, the standard Granger causality (henceforth the *standard* Granger causality called as only *Granger causality*) is commonly used technique for many applications to investigate causal relationships between the datasets (Granger, 1969). This technique simply estimates the basic VAR(p) model as follows:

$$Y_t = \gamma + C_1 Y_{t-1} + \cdots + C_p Y_{t-p} + u_t \qquad (1)$$

where Y_t is measured as a vector of time series variables in time *t,* and γ is a vector of constants. Here, Y_t and γ are n-dimensional vectors, and u_t denotes to the n-dimensional vector of white noise, and C_k represents an $n\ x\ n$ matrix of parameters for lag k.

The Granger causality plays a profound role in obtaining relationships, along with the direction of causality, among time series for many applications in economics, although this test has some limitations under certain conditions. There exist two primary preconditions to be able to apply the Granger causality. First, the integration orders of the time series associated with the same test have to be identical with each other. For instance, the integration numbers of public and private investment datasets for Bahrain need to be same in order to perform the Granger causality between these two-time series. Second, there has to be no co-integration between the time series for conducting the Granger causality to avoid spurious results. To be able to employ the standard Granger causality, these two conditions must be fulfilled in associated time series (there exist few exceptions, see Enders 2014). Toda and Phillips (1994) discussed more about the limitations of the standard Granger causality.

Toda and Yamamoto (1995) proposed a robust, yet simple, approach depending on modified Wald test (this is called as *modified* test due to the *augmented (modified)* VAR model) that is based on augmented VAR(p+d_{max}) model, wherein d_{max} is the maximum integration order of datasets associated together in investigating the causality in between. In this setting, modified Wald statistic converges toward asymptotic χ^2 random variable without depending on neither co-integration nor integration order (Toda & Yamamoto, 1995). Therefore, Toda-Yamamoto (TY) Granger causality test does not require a unit root and cointegration test, thus preventing biased results of the pretest. To perform the TY Granger causality, the augmented VAR(p+d_{max}) model is shown as follows:

$$Y_t = \hat{\gamma} + \widehat{C_1} Y_{t-1} + \cdots + \widehat{C_p} Y_{t-p} + \widehat{C_{p+d_{max}}} Y_{t-p-d_{max}} + \widehat{u_t} \qquad (2)$$

where the circumflex over C_k, γ, and u_t denotes the estimation of ordinary least squares; C_k represents to the $n\ x\ n$ matrix of the parameters for lag k; and d_{max} corresponds to the maximum integration order of the datasets associated together in conducting the causality. There are a

couple of techniques to determine the true lag order p, which is challenging to know a priori, such as Schwarz Information Criterion (SIC), Akaike Information Criterion (AIC), and so on (Akaike, 1974; Schwarz, 1978). By employing the *modified* Wald test on the augmented VAR(p+d_{max}) model, the j^{th} element of Y_t does Granger-cause the i^{th} element of Y_t, if the following null hypothesis H_0 is rejected:

H_0: The (i, j) element of C_k is equal to zero for $k = 1, \dots, p$.

TY Granger causality requires that the true lag order p must be greater than or equal to maximum integration order d_{max} of the datasets. However, if the time series are co-integrated, then p can be less than d_{max} (Toda & Yamamoto, 1995).

3.4. BDS test

Brock et al. (1987) proposed the BDS test utilizing the concept of correlation integral (Grassberger & Procaccia, 1982) to investigate the identically and independently distributed (henceforth, called as i.i.d.) assumption on the error term of a time series by developing and employing an estimator of spatial probabilities over time (Brock, Scheinkman, Dechert, & LeBaron, 1996). Consider an m-dimensional time series X_t, m is called as *embedding dimension*, with its observations $(X_t, X_{t+1}, \dots, X_{t+m-1})$, then the correlation integral can be defined as follows (Chiou-Wei, Chen, & Zhu, 2008):

$$C_m(T, \epsilon) = \frac{2}{T_m(T_{m-1})} \times \sum_{t=1}^{T_m-1} \sum_{s=t+1}^{T_m} I(X_t^m, X_s^m, \epsilon) \tag{3}$$

where $I(X_t^m, X_s^m, \epsilon)$ denotes an indicator function that is equivalent to

$$I(X_t^m, X_s^m, \epsilon) = \begin{cases} 1, & if\ \|X_t^m, X_s^m\| < \epsilon \\ 0, & otherwise \end{cases} \tag{4}$$

here $\|X_t^m, X_s^m\|$ represents the Euclidian distance between X_t^m and X_s^m. T corresponds to the sample size, and T_m is the sub-sample size of the m-embedding dimensions. Brock et al. (1996) defined the BDS statistic with given an m-embedding dimension and a bandwidth of the radius ϵ as follows:

$$W_m(T, \epsilon) = \frac{\sqrt{T}(C_m(T, \epsilon) - C_1(T, \epsilon)^m)}{\sigma_m(\epsilon)} \tag{5}$$

where $\sigma_m(\epsilon)$ is standard deviation of m-embedding dimensional sample. This statistic asymptotically follows a standard normal limiting distribution. As a result of this test, there exists a nonlinear relationship between time series if the null hypothesis can be rejected.

3.5. Nonlinear Granger causality

Granger (1969) causality plays a profound role in drawing conclusions from the linear relations between financial time series. However, most of the time series include many complex components and features that cannot be detected in a linear setting. Therefore, Baek and Brock (1992) (BB) proposed a nonlinear Granger causality after showing that the standard Granger causality has limitations on detecting nonlinearity. Afterwards, Hiemstra and Jones (1994) (HJ) proposed a modified version of the BB test by decreasing nuisance-parameter problems, and enhancing the finite-sample size and power properties against a nonlinear Granger causality. Diks and Panchenko (2006) demonstrated that the HJ test tends to over-reject the null hypothesis. To solve this problem, they proposed a nonparametric test (henceforth, this test called as DP test) for nonlinear Granger causality by replacing the test statistic of the HJ test with a weighted average of local contributions. The null hypothesis of DP test, which is X_t does not Granger-cause Y_t, was reformulated by the local conditional mean as follows:

$$H_0: E\left[f_{X,Y,Z}(X,Y,Z)f_Y(Y) - f_{X,Y}(X,Y)f_{Y,Z}(Y,Z)\right] = 0 \qquad (6)$$

A natural estimator of H_0 based on indicator function, which is defined in the subsection of the BDS test, can be stated as:

$$T_n(\epsilon_n) = \frac{(2\epsilon)^{-d_x-2d_y-d_z}}{n(n-1)(n-2)} \sum_i \left[\sum_{k,k\neq i} \sum_{j,j\neq i} I_{ik}^{XYZ} I_{ij}^{Y} - I_{ik}^{XY} I_{ij}^{YZ} \right] \qquad (7)$$

This statistic can also be interpreted as an average value over the local BDS test for the conditional distribution of X and Z, given $Y \neq y_i$ (see for details Brock et al., (1996)).

To simplify the test statistic, the null hypothesis is presented as the invariant distribution of $W_t = (X_t^{l_x}, Y_t^{l_y}, Y_{t+1})$, considering $l_x = l_y = 1$ and dropping time index t, then it becomes $W = (X, Y, Z)$, which is assumed as a continuous random variable. Afterwards, the local density function of a d_W-variate random vector W at W_i can be stated as

$$\widehat{f_W}(W_i) = \frac{(2\epsilon)^{-d_W}}{n-1} \sum_{j,j\neq i} I_{ij}^{W} \qquad (8)$$

then the test statistic with this estimator becomes as follows:

$$T_n(\epsilon_n) = \frac{n-1}{n(n-2)} \sum_i \left(\widehat{f_{X,Y,Z}}(X_i,Y_i,Z_i)\widehat{f_Y}(Y_i) - \widehat{f_{X,Y}}(X_i,Y_i)\widehat{f_{Y,Z}}(Y_i,Z_i) \right) \qquad (9)$$

Diks and Panchenko (2006) proved that the test statistic $T_n(\epsilon_n)$ fulfills Eq.(12) under a sequence of bandwidths ϵ_n

$$\frac{\sqrt{n}(T_n(\epsilon_n) - q)}{S_n} \xrightarrow{converges} N(0,1) \quad (10)$$

where S_n represents the estimator of the asymptotic standard deviation of $\sqrt{n}(T_n(\epsilon_n) - q)$. We followed the DP test statistic to examine the null hypothesis of nonlinear Granger causality.

4. Empirical Results and Discussions

4.1. Unit root tests

The unit root tests were conducted on the panel data to analyze the stationary status of the time series in level, 1st and 2nd difference. We performed the ADF and ZA test, along with structural time breaks, to determine that which Granger causality (i.e., Toda-Yamamoto Granger causality or the standard one) is suitable for investigating causal relationship. Table 1 reports the results of the ADF test for the panel data consisting of public and private investment. The null hypothesis of the non-stationary time series cannot be rejected in levels for almost all datasets, except for public investment in Qatar.

This result provides an evidence that public and private investment datasets for Bahrain, Kuwait, Oman, Saudi Arabia, and United Arab Emirates are non-stationary in level. In the 1st difference, the findings reveal that both time series are stationary at least at a 5% level of significance, except for public investment in Qatar and Saudi Arabia. In the 2nd difference, we were able to reject the null hypothesis of non-stationary at a 1% significance level for public investment of Saudi Arabia.

Zivot and Andrews (ZA) test was performed to examine the endogenous structural breaks by analyzing the possible shifts in regime of the unit root test. Table 2 shows consistency with the results of the ADF test, given in Table 1, except for private investment in Kuwait. This provides strong evidence that both time series for each country becomes stationary in the same order. Saudi Arabia and U.A.E., which are the countries with the highest oil production in the GCC countries (BP, 2017), present the structural time break for private investment around 1979, which is matching with the large oil shock starting in 1979 (Blanchard & Gali, 2007). Public investment in Qatar has a unique structural time break in 1998 when oil prices plummeted to around $10/barrel (Kohl, 2002). ZA test reveals that public and private investment for Bahrain and Oman has the structural break around 2005. Moreover, recent oil shocks between 2004 and 2008 caused the structural breaks for private investment in Kuwait and Qatar, and public investment in Saudi Arabia and U.A.E. (Kilian & Hicks, 2013).

Table 1: ADF unit root test

	Level		First Difference		Second Difference	
	Test value		Test value		Test value	
Bahrain						
Public investment	-2.1460	(2)	-6.7826	(1)***	-6.2760	(4)***
Private investment	-2.6105	(1)	-4.4369	(1)***	-7.3021	(1)***
Kuwait						
Public investment	-0.4498	(1)	-4.2321	(1)***	-3.7466	(4)***
Private investment	-0.7504	(1)	-5.0339	(1)***	-3.9930	(4)***
Oman						
Public investment	-0.8853	(1)	-4.8808	(1)***	-5.0165	(3)***
Private investment	0.1935	(4)	-6.6408	(3)***	-5.6037	(4)***
Qatar						
Public investment	-4.3327	(4)***	-1.7094	(4)	-3.2015	(3)
Private investment	0.4259	(3)	-3.9615	(2)**	-4.9046	(3)***
Saudi Arabia						
Public investment	-2.1731	(2)	-2.9592	(1)	-6.2995	(1)***
Private investment	1.1314	(1)	-4.2688	(1)***	-4.3769	(3)***
United Arab Emirates						
Public investment	-1.8776	(1)	-5.3081	(1)***	-5.2857	(4)***
Private investment	0.1782	(1)	-4.7435	(1)***	-5.7923	(2)***

*Notes: 1. *, ** and *** indicate significance level at the 10%, 5% and 1%, respectively.*
2. The numbers in parentheses are the lag orders which are selected based on the SIC.

Table 2: ZA unit root tests

	Level			First Difference			Second Difference		
	Test value		Break (year)	Test value		Break (year)	Test value		Break (year)
Bahrain									
Public investment	-4.1197	(2)	1990	-7.6011	(1)***	2004	-7.0203	(4)***	2008
Private investment	-2.8539	(1)	1987	-4.9732	(1)***	2006	-7.3040	(1)***	2012
Kuwait									
Public investment	-2.0798	(1)	2007	-6.3987	(1)***	1984	-4.5469	(4)	1988
Private investment	-5.0848	(1)**	2004	-6.7665	(1)***	2007	-7.8361	(4)***	2006
Oman									
Public investment	-3.9203	(1)	1999	-6.0938	(1)***	2006	-6.0225	(3)***	2009
Private investment	-3.9675	(4)	2001	-15.821	(3)***	2004	-7.8177	(4)***	2003
Qatar									
Public investment	-6.5521	(4)***	1998	-2.1818	(4)	1982	-6.9484	(3)***	2002
Private investment	-4.7291	(3)	2000	-7.4723	(2)***	2005	-6.5352	(3)***	2006
Saudi Arabia									
Public investment	-3.1775	(2)	1990	-4.4153	(1)	2011	-8.7963	(1)***	2008
Private investment	-3.4467	(1)	1999	-5.4753	(1)**	1979	-6.7178	(3)***	2006
United Arab Emirates									
Public investment	-3.4455	(1)	1992	-6.2640	(1)***	2006	-7.2571	(4)***	2005
Private investment	-2.9230	(1)	2004	-5.5799	(1)***	1978	-7.2489	(2)***	2005

*Notes: 1. *, ** and *** indicate significance level at the 10%, 5% and 1%, respectively.*
2. The numbers in parentheses are the lag orders which are selected based on the SIC.

As shown in Table 3, the ADF and ZA test results were consolidated to confirm whether both public and private investment become stationary in the same integration order. There exists an inconclusive finding for Kuwait due to the fact that the ADF and ZA test results for private investment does not match with each other, hence this makes overall result, comparison of integration orders for public and private investment, inconclusive. This means that TY Granger

causality is more appropriate than the standard procedure for investigating the causal relations between the datasets. For Saudi Arabia and Qatar, public and private investments have discrepancy in the integration orders of the ADF and ZA test, thereby confirmatory analysis shows that standard Granger causality is not suitable as much as TY Granger causality. Apart from these, standard Granger causality can be conducted for Bahrain, Oman, and U.A.E. according to the confirmatory analysis if public and private investments do not have co-integration in between for these countries.

Table 3: Confirmatory analysis of integration orders

	ADF	ZA	Result	Conclusion
Bahrain				$I_{pub}(1) = I_{pri}(1) = I(1)$
Public investment	$I_{pub}(1)$	$I_{pub}(1)$	$I_{pub}(1)$	
Private investment	$I_{pri}(1)$	$I_{pri}(1)$	$I_{pri}(1)$	
Kuwait				Inconclusive
Public investment	$I_{pub}(1)$	$I_{pub}(1)$	$I_{pub}(1)$	
Private investment	$I_{pri}(1)$	$I_{pri}(0)$	X	
Oman				$I_{pub}(1) = I_{pri}(1) = I(1)$
Public investment	$I_{pub}(1)$	$I_{pub}(1)$	$I_{pub}(1)$	
Private investment	$I_{pri}(1)$	$I_{pri}(1)$	$I_{pri}(1)$	
Qatar				$I_{pub}(0) \neq I_{pri}(1) = NA$
Public investment	$I_{pub}(0)$	$I_{pub}(0)$	$I_{pub}(0)$	
Private investment	$I_{pri}(1)$	$I_{pri}(1)$	$I_{pri}(1)$	
Saudi Arabia				$I_{pub}(2) \neq I_{pri}(1) = NA$
Public investment	$I_{pub}(2)$	$I_{pub}(2)$	$I_{pub}(2)$	
Private investment	$I_{pri}(1)$	$I_{pri}(1)$	$I_{pri}(1)$	
United Arab Emirates				$I_{pub}(1) = I_{pri}(1) = I(1)$
Public investment	$I_{pub}(1)$	$I_{pub}(1)$	$I_{pub}(1)$	
Private investment	$I_{pri}(1)$	$I_{pri}(1)$	$I_{pri}(1)$	

Notes: 1. PI, ED, and DD stand for public investment, external public debt, and domestic public debt, respectively.
2. The X represents inconclusive results.
3. I(0), I(1), and I(2) corresponds the integration orders in level, 1st difference, and 2nd difference, respectively.
4. The conclusion is obtained by comparing the results of unit root tests (ADF and ZA) for each country.
5. NA stands for Not Applicable meaning that public and private investment are not in the same integration number for the same country. This prevents us to employ standard Granger causality.

4.2. Co-integration test

Engle and Granger (1987) demonstrated that a VAR model in differences would lead spurious results in standard Granger causality if the variables in levels were co-integrated. Therefore, we performed Johansen and Juselius (1990) co-integration tests (i.e., maximum eigenvalue and trace test) to investigate whether public and private investment for each country in level share common trends, meaning that they are co-integrated or not. In the existence of co-integration, VAR(p) model should be replaced either by an error-correction representation (ECM) or augmented VAR($p + d_{max}$) model to avoid spurious results (Engle & Granger, 1987; Toda & Yamamoto, 1995). Apart from that, there exists a long-run causal relationship at least in one direction if the co-integration exists between the time series.

Table 4 reports the cointegration results in both maximal eigenvalue and trace test for the GCC countries. Except for Kuwait and Saudi Arabia, all other countries in the GCC showed apparent co-integration between public and private investment, and hence this indicates that there is at least unidirectional causality for these countries. As a result of this and the confirmatory analysis in the previous subsection, we conducted TY Granger causality in the GCC countries by employing augmented VAR($p + d_{max}$) model to avoid spurious results.

Table 4: Co-integration test results between public and private investment

	Maximal eigenvalue test		Trace test	
	r=0	r=1	r=0	r=1
Bahrain	18.8789*	7.1215	26.0004**	7.1215
Kuwait	15.8748	4.5081	20.3829	4.5081
Oman	32.2065***	4.3605	36.5670***	4.3605
Qatar	45.8807***	5.7912	51.6722***	5.7912
Saudi Arabia	10.8369	8.0927	18.9297	8.0927
United Arab Emir.	33.7321***	3.8732	37.6052***	3.8732

*Notes: 1. *, ** and *** indicate significance level at the 10%, 5% and 1%, respectively.*
2. The lag orders are selected based on the SIC.

4.3. TY Granger causality test

Using the time series in level, TY Granger causality test was conducted between public and private investment for the GCC countries after the VAR($p+d_{max}$) model had been implemented for associated time series. As shown in Table 5, there is at least a unidirectional causality in almost all GCC countries, except for Saudi Arabia. These results are also compatible with the co-integration test, except for Kuwait. There exist two main stream of the nation's behavior on the causal relations between public and private investment, which are (i) a unidirectional causality running from private to public, and (ii) a bidirectional causality between them. For Bahrain and Kuwait, there is a unidirectional causality running from private to public, implying that private investment leads to public investment. In these countries, private investment surprisingly plays a dominant role in spending on public investment. In other words, private investment has considerable amount of influence over public investment, but not vice versa.

Table 5: Results for TY Granger causality test

	Period	d_{max}	k	Null hypothesis	Chi2	P-value
Bahrain	1960-2015	1	3	Public ≠> Private	0.47976	0.923315
		1	3	Private ≠> Public	17.1164***	0.000669
Kuwait	1960-2015	1	2	Public ≠> Private	1.08909	0.580104
		1	2	Private ≠> Public	13.7845***	0.001016
Oman	1960-2015	1	8	Public ≠> Private	28.9568***	0.000323
		1	8	Private ≠> Public	73.4982***	$9.85\text{x}10^{-13}$
Qatar	1960-2015	2	10	Public ≠> Private	82.9893***	$1.30\text{x}10^{-13}$
		2	10	Private ≠> Public	146.5779***	0.000000

Saudi Arabia	1960-2015	2	4	Public ≠> Private	1.65884	0.798181
		2	4	Private ≠> Public	5.14638	0.272605
United Arab Emirates	1960-2015	1	9	Public ≠> Private	69.7103***	$1.74x10^{-11}$
		1	9	Private ≠> Public	70.7708***	$1.07x10^{-11}$

Notes: 1. "Public" and "private" stand for public investment and private investment, respectively.
2. The augmented lag order k equals d_{max}+ p. The lag parameters p are chosen based on AIC.
*3. *, ** and *** indicate significance level at the 10%, 5% and 1%, respectively.*
4. The null hypothesis X ≠=>Y means variable X does not Granger cause variable Y.
5. The condition $d_{max} \leq p, (p = k - d_{max})$, must be satisfied only for Kuwait and Saudi Arabia due to the cointegration results.
6. The maximum integration numbers (d_{max}) are taken from a stronger stationary state in the confirmatory analysis.

For Oman, Qatar, and the U.A.E., strong bidirectional causality exists between public and private investment at 1% significance level. In this regard, public investment leads to private investment, and vice versa is also true. This might be a push-and-pull strategy for public and private investment in order to implement dynamic decision-making policy and practice. Finally, Saudi Arabia does not show any causal relationship with the associated time series. We also concern about the nonlinear relationship for the GCC countries, and thereby we performed the BDS test to investigate nonlinearity in the time series. In this regard, the nonlinear Granger causality test would provide more convenient results than the TY Granger causality if there were nonlinearity.

4.4. BDS Test

The BDS test was conducted on the residual series of VAR models to test for nonlinearity of the time series (Brock et al., 1987). BDS test statistic for the null hypothesis states that public investment is a series of *independent and identically distributed* (i.i.d.) random variables. This means that if the assumption of null hypothesis is rejected, then the time series can be considered that nonlinearity may be embedded in the series. In that case, the nonlinear Granger causality test would give us more convenient results than the TY Granger causality. We performed the BDS test for only public investment data in order to understand nonlinear interrelationship between public and private investment. Because if there is a nonlinearity in only one of the time series, then this is enough to draw a conclusion that there may be a nonlinear interrelationship in between them.

Table 6 shows the BDS test results on the residuals of VAR model for public investment. In almost all cases, the null hypothesis, which is the i.i.d. assumption, can be rejected for the entire GCC countries under different dimensions, but the same epsilon value (0.5) for close points in terms of standard deviation (SD). This suggests that nonlinear interrelationship between public

and private investment is likely to exist in the residuals. Therefore, nonlinear Granger causality test to investigate the causal relationship between public and private investment yields more convenient results than linear Granger causality. In this regard, we performed the nonlinear Granger causality proposed by Diks and Panchenko (2006) to complement our analysis on causal relationship.

Table 6: BDS statistic for the public investment series

Length in S.D.	Embedding Dimensions	W statistic					
		Bahrain	Kuwait	Oman	Qatar	K.S.A.	U.A.E.
0.5	2	10.2675***	1.43525	2.47481**	5.69735***	2.89400***	4.94277***
0.5	3	10.2591***	1.72802*	2.11626**	6.71867***	2.64874***	4.59114***
0.5	4	9.69921***	2.38684**	1.77533*	6.36279***	3.98370***	4.31770***
0.5	5	9.47944***	1.97526**	2.65354***	5.93010***	3.58185***	3.76289***
0.5	6	9.44398***	3.20073***	2.23889**	5.51044***	3.19764***	3.57811***
0.5	7	9.45743***	2.89029***	3.21952***	5.45623***	2.75554***	3.20851***
0.5	8	10.1422***	2.52289**	2.80177***	4.85170***	2.50841**	2.73134***
0.5	9	13.2073***	3.80302***	3.97556***	4.19522***	2.12346**	2.21439**
0.5	10	13.0750***	3.66673***	3.92358***	3.21787***	1.77182*	3.58562***

Notes: 1. Test results are based on the residuals of a VAR model.
*2. *, ** and *** indicate significance level at the 10%, 5% and 1%, respectively.*

4.5. Nonlinear Granger Causality

As a result of the BDS test, a possibility of nonlinear interrelationship between public and private investment was investigated by conducting nonlinear Granger causality test (Diks & Panchenko, 2006) on the residuals of VAR model of associated time series, public and private investment. According to Diks and Panchenko (2006), we set optimal bandwidth to 1.5 due to fact that the number of observation is less than 500. The number of lags is set to L_{public}=$L_{private}$=1, 2, 3, 4, 5, 6, 7, and 8. Table 7 reveals the results of nonlinear Granger causality for GCC countries and Table 8 demonstrates an overview of the results for linear and nonlinear Granger causality tests.

Table 7: Results for nonlinear Granger causality test

L_x=L_y	H_0: Public ≠> Private	P-value	H_0: Private ≠> Public	P-value
Bahrain				
1	0.50609	0.30639	0.80360	0.21081
2	0.08950	0.46434	1.50580*	0.06606
3	1.43640*	0.07544	1.34391*	0.08949
4	1.08126	0.13979	1.23458	0.10849
5	1.12458	0.13038	0.41555	0.33887
6	0.57130	0.28390	0.59049	0.27743
7	0.74259	0.22886	0.53913	0.29490

8	0.53090	0.29774	1.04775	0.14738
Kuwait				
1	-1.74893	0.95985	0.59971	0.27435
2	-1.34878	0.91130	-1.07006	0.85770
3	-0.14305	0.55687	0.24111	0.40473
4	-0.18271	0.57249	0.76869	0.22104
5	0.19854	0.42131	0.35817	0.36011
6	0.96543	0.16716	0.19681	0.42199
7	0.93877	0.17392	0.05645	0.47749
8	0.70361	0.24083	0.18438	0.42686
Oman				
1	2.39395***	0.00833	0.84002	0.20045
2	2.01896**	0.02175	0.63353	0.26319
3	1.71283**	0.04337	0.89081	0.18652
4	1.60231*	0.05454	0.53944	0.29479
5	1.57253*	0.05791	-0.22337	0.58838
6	1.61946*	0.05267	-0.25378	0.60017
7	1.57361*	0.05779	0.34222	0.36609
8	1.54505*	0.06117	0.74030	0.22956
Qatar				
1	0.96629	0.16695	1.23188	0.10899
2	2.42474***	0.00766	1.18773	0.11747
3	2.05276**	0.02005	0.90985	0.18145
4	1.52238*	0.06396	0.32215	0.37367
5	1.28470*	0.09945	-0.04682	0.51867
6	1.01782	0.15438	-0.19266	0.57639
7	0.89872	0.18440	-0.59304	0.72342
8	0.32149	0.37392	-0.94975	0.82888
Saudi Arabia				
1	-1.70589	0.95599	1.42453*	0.07715
2	0.58769	0.27837	1.92114**	0.02736
3	1.16173	0.12267	1.92018**	0.02742
4	1.59696*	0.05514	1.77818**	0.03769
5	1.12932	0.12938	1.55854*	0.05955
6	1.11066	0.13336	1.38471*	0.08307
7	1.02777	0.15203	1.23868	0.10773
8	0.73411	0.23144	1.28232*	0.09987
U.A.E.				
1	1.70726**	0.04388	0.80529	0.21032
2	1.46133*	0.07196	0.72656	0.23375
3	1.05800	0.14503	0.37518	0.35376
4	1.09874	0.13594	0.42371	0.33589
5	0.81751	0.20682	0.30383	0.38063
6	0.69892	0.24230	0.65361	0.25668
7	0.43697	0.33107	0.52536	0.29967
8	-0.46099	0.67760	0.85839	0.19533

Notes: 1. Test results are based on the residuals of a VAR model.
2. Lx = Ly denotes the number of lags on the residuals series used in the test.
3. In all cases, optimal bandwidth is set to 1.5 due to the relatively small sized sample according to Diks and Panchenko (2006).
*4. *, ** and *** indicate significance level at the 10%, 5% and 1%, respectively.*
5. The null hypothesis X≠>Y means variable X does not Granger cause variable Y.

A nonlinear Granger causality interrelationship between public and private investment was found to exist in five countries, namely Bahrain, Oman, Qatar, Saudi Arabia, and U.A.E., except for Kuwait. For Bahrain, there is weak but significant bidirectional nonlinear Granger causality between public and private investment while having a strong unidirectional linear Granger causality running only from private to public investment. For Kuwait, there is no any nonlinear

Granger causality between associated time series whereas private investment strongly and significantly Granges causes public investment in linear Granger causality. For Oman, Qatar, and UAE, the nonlinear Granger causality from public to private investment is significant but inconsistent with the result of bidirectional causality from linear model. This provides strong evidence that the causation from public to private exists for these three countries in both linear and nonlinear model. Saudi Arabia has a bidirectional nonlinear Granger causality between public and private investment in contrast to linear model with the nonexistence of causality.

Table 8: Overview of causality test results

		H_0: Public ≠> Private	H_0: Private ≠> Public
Bahrain	Linear Granger causality	✗	✓
	Nonlinear Granger causality	✓	✓
Kuwait	Linear Granger causality	✗	✓
	Nonlinear Granger causality	✗	✗
Oman	Linear Granger causality	✓	✓
	Nonlinear Granger causality	✓	✗
Qatar	Linear Granger causality	✓	✓
	Nonlinear Granger causality	✓	✗
Saudi Arabia	Linear Granger causality	✗	✗
	Nonlinear Granger causality	✓	✓
United Arab Emirates	Linear Granger causality	✓	✓
	Nonlinear Granger causality	✓	✗

Notes: 1. The null hypothesis X≠>Y means variable X does not Granger cause variable Y.

4.6. Key Findings

To the best of our knowledge, this is the first study investigating the quantitative relationships between public and private investments for the GCC countries. In this regard, the key findings in this study can be summarized as follows:

- Despite the fact that all of the GCC countries have their own agenda as a national vision emphasizing economic diversification, structural time breaks show that these states are still rentier economies, and could not achieve outright economic diversification as yet. Because these countries are still heavily dependent on oil and natural gas resources, and thereby all of the break points have occurred at the time of oil crises.
- The GCC countries do not have unidirectional linear causality running from public investment to private investment in spite of having bidirectional causality among them. However, the linear causality could not reveal the exact and true relationship between public and private investment due to the existence of nonlinearity in the datasets according to the BDS test. In other words, the findings are biased against public investment in the linear Granger causality test.

- Bahrain is considered relatively more diversified economy than other GCC countries, except for Saudi Arabia, because of having considerably less oil and natural gas reserves. This diversification has taken place in the financial services by the private sector since 1973 with the launch of offshore banking units in supplement to private capital flight from Lebanon during the civil war. The development of financial market is a primary ingredient of the economy in Bahrain, rather than hydrocarbon-based revenues. Furthermore, Bahrain has been desperately seeking foreign direct investment and attracting some as well due to the lack of enough natural resources to grow its economy. Because of these reasons, it is possible to justify that private investment leads to public investment in the linear settings of Granger causality. Behind this scene, there is, however, bidirectional causality between public and private investment in the nonlinear settings, which is not bad if this relation is managed well in terms of promoting private investment.
- Kuwait has shown similar trend with Bahrain in the linear settings that is a significant linear Granger causality running from private to public investment. However, the results from linear causality cannot represent true relationship between public and private investment because there exists nonlinearity in the datasets according to the BDS test. In other words, the results are biased towards private investment in the linear settings while expecting more accurate and suitable results from nonlinear causality. In the manner of nonlinear Granger causality, Bahrain has not any nonlinear relations between public and private, even though there exists nonlinearity in the datasets. This provides evidence supporting the neutrality hypothesis, which means that public investment may not affect private investment, and vice versa.
- Oman, Qatar, and U.A.E. presented enthusiastic objectives in their national visions indicating strong desires for economic diversification and knowledge-based economy (ONV 2020, 2013; QNV 2030, 2008; The Abu Dhabi 2030, 2008). In this regard, these countries have been trying to promote private participation in the economy as evidenced in the case of linear causality, but still public investment leads to private investment as evidenced from nonlinear Granger causality. Although U.A.E. becomes the financial hub and business center in the region by attracting private sector while steering public sector in linear setting, this does not exactly reflect onto the public investment's role behind the scene, which is more dominant than private investment. Similarly, Qatar has exhibited rapid economic development during recent years that brought a population boom through expatriates and private sector in front of public investment in the linear setting, but it is still heavily reliant on public investment in terms of nonlinear setting.

As for Oman, it has the lowest hydrocarbon revenue with respect to the earnings from export (65%) and the second lowest with respect to the share of GDP (41%) (Hvidt, 2013). These statistics has exerted a need on the investment structure and enforced alternative revenue streams rather than natural resources. Fortunately, Oman has located in a geographically strategic point of the region and exploited this feature as leverage by being a port country for international trade. For this reason, Oman presents unidirectional linear causality running from private investment to public investment, but this re-export and trading facilities requires substantial public investment that governs private investment in nonlinear settings.

- Saudi Arabia has more complex economy than the other GCC countries because it has higher GDP, larger population and land than the rest. The linear causality cannot reveal the complex relationships concealed by the nonlinearity of the datasets. Therefore, linear Granger causality test does not show any relationship between public and private investment. However, there is nonlinearity in the datasets according to the BDS test in Saudi Arabia, and thereby this study conducted nonlinear Granger causality. As a result of this test, Saudi Arabia shows bidirectional causality between public and private investment.

5. Recommendations and Conclusions

As a result of above findings, the nonlinear causality reveals that the entire GCC countries have at least a unidirectional causality running from public investment to private investment, and in addition to this, Bahrain and Saudi Arabia have bidirectional causality. In this sense, it can be concluded that public investment has played a profound role in the development of the countries between 2000 and 2015. State budgets of the GCC, which is the main source of public investment, consists of mainly hydrocarbon-based revenue changing in different levels from 77 to 93 percent (Hvidt, 2013). This means that the development of the GCC heavily relies on public investment, and public investment hinges on the natural resources, and thereby development of the GCC countries are strongly dependent on oil and natural gas resources and price fluctuations. Therefore, it can be easily stated that the GCC countries are still rentier, oil/gas-based economies as evidenced by the non-linear causality running from public investment to private investment, although the linear causality, which is biased to public investment due to the non-linearity in the datasets, shows the opposite direction.

This study extracts the meaning of biased-linear causality running from private to public investment by stating that these countries fortunately realize the fact that they need to take an

action to be free of being rentier states by diversifying their economies according to their national visions (BNV 2030, 2015; KDP 2020, 2015; KSAV 2030, 2008; ONV 2020, 2013; QNV 2030, 2008; The Abu Dhabi 2030, 2008). To accomplish such envisioned economic diversification, there are two main conditions for the GCC countries as follows: (i) decreasing the share of hydrocarbon-based revenue in the state budget, and (ii) promoting the private investment together with public investment. Therefore, the GCC countries need to attract private investment through incentive policies to balance their public and private investment by diversifying their economies. To promote private investment, there are few issues that need to be addressed as follows:

- Pursue, without any compromise, the national visions that clearly aim for economic diversification from hydrocarbon dependency to the real sector and knowledge-based economy. To accomplish this task, private sector has become crucial to be promoted for private investment by the governing authorities. In this regard, the government needs to establish institutional and relational trust between the state, ruling elite(s) and the private sector based on a larger portion of their population. Private sector should feel secure in terms of calculative risks and investment failures.
- Provide access to quality education and relevant skills-based training for the entire society, local people in particular, in order to increase labor productivity and flexibility and develop a social and cultural awareness for establishing and running technology oriented high-quality entrepreneurial activities that benefit the future generations.
- Change social attitude towards private investments by developing human resources, which requires public investment as well.
- Cultivate the social attachment between business and society, which provides to the private investor the feeling of belonging to the society. By attaining this attachment, private investors will have an intrinsic motivation that is willingness to invest more in the country.
- Legislate and amend policies towards encouraging entrepreneurs (individuals and private entities) and private investment by giving attractive incentives and official support for making business easy such as providing land, lifting any restriction in regard to business establishment and operation, reducing tax (if applicable), facilitating export, and awarding success.
- Investigate appropriate and specific economic and financial opportunities for the GCC countries, private sector in particular, in terms of their geography, climate, population, language, and even religion. For instance, private sector can attract many students by

building new private schools to offer Arabic language and culture with a high quality services around it.

- Facilitate international trade to export the goods manufactured in the GCC and re-export to outside the region in particular.
- Reduce the number of expats, which varies from 50 to 95 percent of workforce in the GCC (Forstenlechner & Rutledge, 2011), by either laying out smart and transparent roadmaps towards citizenship for highly skilled expatriates or replacing them with local workforce of same qualities. By all means, this is only possible when inclusive and high-quality education system is established and pursued with diligence.

This study assumes that private funds do not consist of oil revenues even though this is not exactly true. In this case, Bahrain and Saudi Arabia performed very well in terms of nonlinear causality that shows bidirectional causality between public and private investment. This is the ideal case for the investment structure because public and private investments are moving together by steering each other. However, the state budgets of these two countries comprise about 85 percent of the hydrocarbon revenues (Hvidt, 2013). This fact cannot satisfy the first condition mentioned above to be able to move out of rentier statehood conditions. To escape from this trap, these countries need to design and implement progressive policies tailored to attract more private investment in different sectors to generate non-oil/gas-based income.

References:

Akaike, H. (1974). A New Look at the Statistical Model Identification. *IEEE Transactions on Automatic Control*, *19*(6), 716–723. http://doi.org/10.1109/TAC.1974.1100705

Aschauer, D. A. (1989). Does public capital crowd out private capital? *Journal of Monetary Economics*, *24*(2), 171–188. http://doi.org/10.1016/0304-3932(89)90002-0

Baek, E., & Brock, W. (1992). A general test for nonlinear Granger causality: Bivariate model. *Iowa State University and University of Wisconsin at Madison Working Paper*.

Blanchard, O. J., & Gali, J. (2007). *The Macroeconomic Effects of Oil Shocks: Why are the 2000s So Different From the 1970s? NBER Working Paper*.

BNV 2030. (2015). *The Economic Vision 2030 For Bahrain*.

BP. (2017). BP Statistical Review of World Energy 2017. *British Petroleum*, (66), 1–52. http://doi.org/http://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review-2017/bp-statistical-review-of-world-energy-2017-full-report.pdf

Brock, W. A., Dechert, W. D., & Scheinkman, J. A. (1987). *A test for independence based on the correlation dimension*. Madison.

Brock, W. A., Scheinkman, J. A., Dechert, W. D., & LeBaron, B. (1996). A test for independence based on the correlation dimension. *Econometric Reviews*, *15*(3), 197–235.

Cavallo, E., & Daude, C. (2011). Public investment in developing countries: A blessing or a curse? *Journal of Comparative Economics*, *39*(1), 65–81. http://doi.org/10.1016/j.jce.2010.10.001

Chiou-Wei, S. Z., Chen, C.-F., & Zhu, Z. (2008). Economic growth and energy consumption revisited — Evidence from linear and nonlinear Granger causality. *Energy Economics*, *30*(6), 3063–3076. http://doi.org/10.1016/j.eneco.2008.02.002

Dickey, D. A., & Fuller, W. A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, *49*(4), 1057–1072.

Diks, C., & Panchenko, V. (2006). A new statistic and practical guidelines for nonparametric Granger causality testing. *Journal of Economic Dynamics and Control*, *30*(9–10), 1647–1669. http://doi.org/10.1016/j.jedc.2005.08.008

Enders, W. (2014). *Applied Econometric Time Series*. *Technometrics* (Fourth, Vol. 46). Wiley. http://doi.org/10.1198/tech.2004.s813

Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction : Representation , Estimation , and Testing. *Econometrica*, *55*(2), 251–276.

Erden, L., & Holcombe, R. G. (2005). The effects of public investment on private investment in developing economies. *Public Finance Review*, *33*(5), 575–602. http://doi.org/10.1177/1091142105277627

Everhart, S. S., & Sumlinski, M. a. (2001). Trends in Private Investment in Developing Countries. *International Finance Corporation*, (44).

Forstenlechner, I., & Rutledge, E. J. (2011). The GCC's "Demographic Imbalance": Perceptions, Realities and Policy Options. *Middle East Policy*, *18*(4), 25–43.

Granger, C. W. J. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. *Econometrica*, *37*(3), 424–438.

Grassberger, P., & Procaccia, I. (1982). Measuring the strangeness attractors. *Physica D*, 170–189.

Hassan, S., Othman, Z., & Zaini, M. K. (2011). Private and Public Investment in Malaysia : A Panel Time-Series Analysis. *International Journal of Economics and Financial Issues*, *1*(4), 199–210.

Hiemstra, C., & Jones, J. D. J. (1994). Testing for Linear and Nonlinear Granger Causality in the Stock Price-Volume Relation. *The Journal of Finance*, *49*(5), 1639–1664.

Hvidt, M. (2013). *Economic diversification in GCC countries : Past record and future trends*.

Hyder, K., & Qayyum, A. (2001). Crowding-out Hypothesis in a Vector Error Correction Framework: A Case Study of Pakistan[with Comments]. *The Pakistan Development Review*, *40*(4).

IMF. (2017a). Estimating the stock of public capital in 170 countries. *Fiscal Affairs Department*.

IMF. (2017b). *FAD INVESTMENT AND CAPITAL STOCK DATABASE 2017: ESTIMATING PUBLIC, PRIVATE, AND PPP CAPITAL STOCKS This*. *Fiscal Affairs Department*.

Johansen, S. (1992). Testing weak exogeneity and the order of cointegration in UK money demand data. *Journal of Policy Modeling*, *14*(3), 313–334. http://doi.org/10.1016/0161-8938(92)90003-U

Johansen, S., & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration - with Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169–210. http://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

KDP 2020. (2015). Kuwait mid-range development plan 2015/2016 – 2019/2020, (May 2015).

Khan, M. S., & Kumar, M. S. (1997). Public investment and private investment and the growth process in developing countries. *Oxford Bulletin of Economics and Statistics*, *59*(1), 69–88.

Khan, M. S., & Reinhart, C. M. (1990). Private investment and economic growth in developing countries. *World Development*, *18*(1), 19–27. http://doi.org/10.1016/0305-750X(90)90100-C

Kilian, L., & Hicks, B. (2013). Did unexpectedly strong economic growth cause the oil price shock of 2003-2008? *Journal of Forecasting*, *32*(5), 385–394. http://doi.org/10.1002/for.2243

Kohl, W. L. (2002). OPEC behavior, 1998 –2001. *The Quarterly Review of Economics and Finance*, *42*(August 2001), 209–233.

KSAV 2030. (2008). *Vision 2030 Kigdom of Saudi Arabia*.

Looney, R. E. (1995). Public Sector Deficits and Private Investment: A Test of the Crowding- out Hypothesis in Pakistan's Manufacturing Industry. *Pakistan Development Review*, *Autumn*.

Mallick, H., Mahalik, M. K., & Sahoo, M. (2018). Is crude oil price detrimental to domestic private investment for an emerging economy? The role of public sector investment and financial sector development in an era of globalization. *Energy Economics*, *69*, 307–324. http://doi.org/10.1016/j.eneco.2017.12.008

Naqvi, N. H. (2002). Crowding-in or crowding-out? Modelling the relationship between public and private fixed capital formation using co-integration analysis: The case of Pakistan 1964-2000. *Pakistan Development Review*, *41*(3), 255–276.

Naqvi, N. H., & Tsoukis, C. (2003). Does Public Investment Crowd Out Private Investment? Evidence On Investment And Growth In Asia, 1971-2000. *European Research Studies*, *VI*(1–2), 58–72.

Nazmi, N., & Ramirez, M. D. (1997). Public and private investment and economic growth in Mexico. *Contemporary Economic Policy*, *15*(1), 65–75. http://doi.org/10.1111/j.1465-7287.1997.tb00455.x

ONV 2020. (2013). *Oman 20/20 Vision*.

Pereira, A. M. (2001). On the Effects of Public Investment on Private Investment: What Crowds in What? *Public Finance Review*, *29*(1), 3–25.

QNV 2030. (2008). *Qatar National Vision 2030*.

Saeed, N., Hyder, K., Ali, A., & Ahmad, E. (2006). Pakistan Institute of Development Economics , Islamabad The Impact of Public Investment on Private Investment : A Disaggregated Analysis [with Comments] Author (s): Noman Saeed , Kalim Hyder , Asghar Ali and Eatzaz Ahmad Source : The Pakistan Developm. *The Pakistan Development Review*, *45*(4).

Schwarz, G. (1978). Estimating the Dimension of a Model. *The Annals of Statistics*, *6*(2), 461–464. http://doi.org/10.1214/aos/1176344136

The Abu Dhabi 2030. (2008). *The Abu Dhabi Economic Vision 2030*.
Toda, H. Y., & Phillips, P. C. B. (1994). Vector autoregressions and causality: a theoretical overview and simulation study. *Econometric Reviews*, *13*(February 2013), 37–41.
Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, *66*, 225–250.
Zivot, E., & Andrews, D. W. K. (1992). Further Evidence on the Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Journal of Business & Economic Statistics*, *10*(3), 251–270. http://doi.org/10.1198/073500102753410372

Appendix A

A1. GCC Countries by GDP

A2. Populations for GCC countries

A3. Data Resources

Table 3: Data sources and periods with respect to datasets

Dataset	Data Source	Country	Period
Public Investment	IMF FAD Investment and Capital Stock Dataset	Bahrain	1960-2015
		Kuwait	1960-2015
		Oman	1960-2015
		Qatar	1960-2015
		Saudi Arabia	1960-2015
		U.A.E.	1960-2015
Public Investment	IMF FAD Investment and Capital Stock Dataset	Bahrain	1960-2015
		Kuwait	1960-2015
		Oman	1960-2015
		Qatar	1960-2015
		Saudi Arabia	1960-2015
		U.A.E.	1960-2015